Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

# THE FISHING BANKS OFF OUR ATLANTIC COAST

By GEORGE CARROLL CURTIS

(Map facing p. 420.)

## ORIGIN OF THE BANKS ON THE ATLANTIC COASTAL SHELF OF NORTH AMERICA.

During a recent trip (March 16 to 28, 1912), taken on a market fishing schooner to Georges Bank and other of the outer great fishing grounds lying off the Gulf of Maine, a comprehensive collection of specimens was obtained. From the armed sounding lead the nature of the finer material of the bottom could be seen, and rocks up to six to eight inches in diameter were drawn up by the marine growths attached.becoming entangled in the fishermen's gear. The character and variety of this collected material give evidence of the origin of these off-shore banks, and the deductions appear to have considerable bearing on the present vital subject of conserving our most important source of common fresh fish supply.

Georges Bank is a shoal of the sea lying in the open ocean about 100 miles east-southeast of Cape Cod. The depth of this bank, which is roughly 70 miles square in extent, averages from 15 to 30 fathoms, though in its middle portion there are spots with so little as 12 feet of water over them where, in storm, seas run ''mountain high.'' Between this shoal ground and the mainland there are depths of over 100 fathoms, nearly 900 feet being found in spots, while on the eastern side the water falls off rapidly from the 50 fathom to the 100, 500 and 1,000 fathom line of true oceanic depths.

To the west, between Georges Bank, on the one hand, and the lands of Cape Cod and the shoals of Nantucket on the other, is what mariners call ''the Channel,'' with depths from 50 to 100 fathoms, while to the north of Georges Bank is another trough where the soundings average considerably over 100 fathoms, or 600 feet. These ''gullies'' probably represent old channels once draining northern New England. On the north side of this deep gully lies a shoal ground of similar depth and character as Georges Bank, but only about a third as large in area, known as Browns Bank, some 60 miles off Cape Sable, Nova Scotia, from which it is separated by a moderately deep depression. These elevated portions of the sea bottom are so situated that they have long been the chief source of the fresh fish supply for the eastern seaboard of the United States.

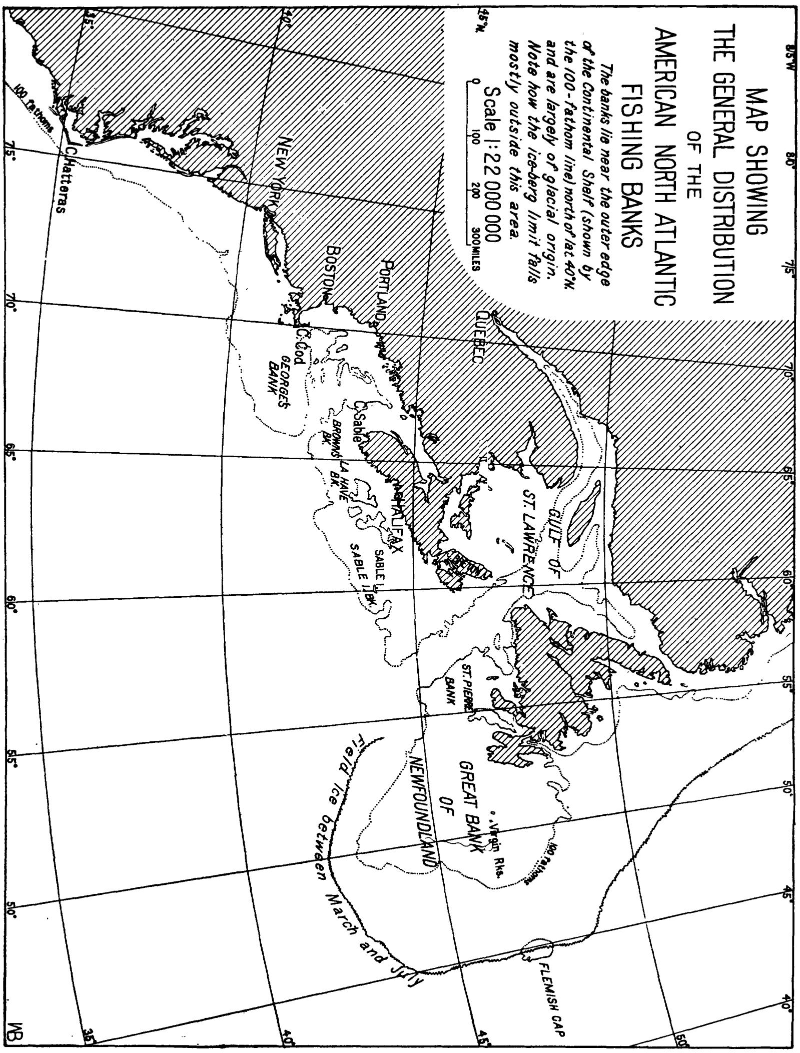
There are various other banks or off-shore shoals along the Nova

Scotia, Cape Breton and Newfoundland coasts, terminating in the largest of all, the Grand Banks of Newfoundland. All these lie upon the comparatively shallow marine margin bordering the Atlantic coast, known as the continental shelf, which is usually assumed to be composed of the waste worn from the lands and deposited in the sea along the shore margin of its basin. It has been held, indeed, that the greater width of this Atlantic shelf, compared to the narrow bordering coastal rim in the same latitude on the Pacific side of the continent, has been gained through the laying down of a vast amount of detritus, the remains of lofty mountains whose roots alone now exist upon our north Atlantic coast. Be this as it may, another factor seems to have played a very important part in this upbuilding of the continental border and appears to be the chief agent in the origination of at least the shoaler parts, which constitute the best fishing grounds of North America and probably of the world.

The material recently collected from Georges Bank and Browns Bank bears the stamp of glacial origin. There is a variety similar to that found in glacial deposits on the mainland. The pebbles, boulders and sand which constitute the bottom are characteristically glacier-worn rather than water-worn, as would result were these banks essentially of littoral or marine origin. The rocks are largely subangular, of great variety of formation and mineral content.

Two lines of deposits mark the southernmost limits of the great ice sheet, which occupied the northern portion of this continent in Pleistocene times. The outer moraine, where the materials brought by the glacier, sand, gravel and boulders, etc., were left, can be readily traced. On the Atlantic border of the southeast coast of Massachusetts, it largely built up the morainal islands of Nantucket and Martha's Vineyard, whose gentle south-sloping plains represent the sands washed out from the old retreating ice-front, and whose rough and hummocky exterior or backbone, the irregular surface produced under the moving ice margin. This well-defined terminal moraine continues westward, appearing again in No Man's Land and Block Island and forming the ''keel'' of Long Island, from whence it is traced through Staten Island, northern New Jersey, southern Pennsylvania, through Ohio to the junction of the Ohio and Mississippi, sweeping westward into Kansas, and then northward through Nebraska and Dakota.

The islands south of New England do not constitute the original limit of the glacial deposits, for the ocean has been eating back the land during thousands of years, and the sea of shoals which extends some 40 to 50 miles to the south of Nantucket undoubtedly indicates


MAP SHOWING
THE GENERAL DISTRIBUTION
OF THE
AMERICAN NORTH ATLANTIC
FISHING BANKS
The banks lie near the outer edge of the Continental Shelf (shown by the 100-fathom line) north of lat. 40°N. and are largely of glacial origin. Note how the ice-berg limit falls mostly outside this area.
Scale 1:22 000 000
0 100 200 300 MILES
85°W
80°
75°
70°
65°
60°
55°
50°
45°
40°
35°
45°N.
40°
NEW YORK
BOSTON
PORTLAND
QUEBEC
C. Hatteras
100 fathoms
C. Cod
GEORGE'S BANK
C. Sable
BROWNS BK.
LA HAVE BK.
HALIFAX
SABLE I.
SABLE I. BK.
GULF OF ST. LAWRENCE
ST. PIERRE BANK
GREAT BANK OF NEWFOUNDLAND
Virgin Rks.
100 fathoms
FLEMISH CAP
Field Ice between March and July
WB

their former extent. It seems that the present 20 fathom curve is a conservative estimate for one of the ancient shore lines. If the depth of the old channel of the Hudson River in the coastal shelf be taken as evidence, there is ground for holding that in the region of New York the land once reached over 100 miles farther to sea, during which time Boston's site probably lay twice that distance inland.

We have conclusive evidence that movements of the land along this portion of the Atlantic Coast, both of elevation and depression, have taken place in the past and are even going on at present. Old shore lines where the changes of level of 160 to 300 feet are distinctly shown occur on the islands and shores of the coast of Maine. Professor Shaler stated his view that evidence of a change of level of over 1,000 feet was to be found at Mt. Desert, and detailed studies for the past two seasons, along the Maine, Nova Scotia, Cape Breton and Newfoundland coasts, have borne out this view.

At the time when the land stood at the very moderate higher elevation of some 120 feet, Cape Cod would have extended 5 miles farther to the eastward and the land about Nantucket 30 miles seaward.

Georges Bank under such conditions might appear as an island over 100 feet above the sea, resembling Nantucket and Martha's Vineyard, though of twice the size of their combined areas. The evidence is that such was a former configuration of the coast, and that there lay at a little over 100 miles off the Massachusetts shore an island about half the size of Ireland, a true Atlantis out at sea.

The changes of level which took place along the northern Atlantic coast in Pleistocene times have not been uniformly in one direction nor of continuous regularity over broad areas. In some portions, as in the vicinity immediately south of Portland, Maine, the general character of the bordering lands is that of an elevated coast plain, while in the region of Penobscot Bay the coast is typical of the half-drowned stage of submergence. Still other localities, including some of the outlying drift-covered Maine coast islands, present evidence of having remained at their present level, at least since the glacial epoch. This stationary attitude, however, appears to have been the exception, and differential oscillatory movements, both of depression and elevation, have formed the ruling condition. The submergence of over 2,000 feet, indicated by the still traceable portion of the old Hudson River channel, gives on our coast opportunity to measure a greater change below sea level than the coastal elevation of 1,500 feet at Mt. Desert Island affords for determining how great the maximum uplift has been. The southern coastline of Newfoundland with its thousand feet elevations confirms the view of

Shaler that the summit of Mt. Desert Island bore evidence of the former presence of the sea. With the records of elevations and depressions of over 1,000 feet there is no difficulty in assuming the few feet of movement required to convert the shoals of Georges Bank into an island, farther from the coast and greater in size than any now existing. The former presence of an Atlantis 100 miles at sea between Boston and New York is seen to rest on rational geological factors.

The fishing banks, then, lie on the continental platform which reaches along our Atlantic coast in the form of a shelf gently dipping from the land into a hundred fathoms of water, where, in a quick descent, it drops steeply to the thousand fathom depths of the ocean floor. Off Cape Hatteras the width of this shallow margin is but 20 miles, but this gradually increases northward until, in the vicinity of Sandy Hook, it has a breadth of about 100 miles, while off the New England shore it extends twice this distance to sea. The marked increase in width towards the north takes place as the southern unglaciated area is left, suggesting that the coincidence has connection with the extended submerged land rim. It would seem that the greater width of the coastal shelf, though undoubtedly connected with coastal submergence, must have been considerably increased by the addition of glacial deposits.

The islands of Nantucket, Martha's Vineyard, Block Island and Long Island represent for the most part great terminal sand plains built from the waste washed out from a glacier front, and their arrangement is doubtless connected with interlobe effects produced through the ice splitting against Mt. Washington, Mt. Katahdin and other of the higher summits of northern New England. The former southward extent of these morainal islands may be traced in the shoal water reaching near 100 miles seaward; indeed, there is now but a shallow channel separating Nantucket Shoals from Georges Bank, which it would require only some minor change of level, when compared with what has taken place in the past, to join by continuous land. It is thus but a short step from the formation of Georges Bank to that of the Elizabeth Islands, and it seems logical to hold that Georges Bank and Browns Bank are but underwater representations of the terminal moraine sand plains which lie above water to the westward. The materials drawn up from the fishing grounds bear out this view. Moreover, the general configuration of the open ocean shoals and their detail of bottom form, the kettle and kame topography and the backbone of irregular moraine deposit attributed to the over-riding of the glacial cover, seem to be traceable by soundings. Many such holes and hillocks of the bottom were detected by our sounding lead suddenly slipping into increased depths of five to eight fathoms.

From the fact that these outer shoals lie on the continental shelf and are confined mostly to the outer terminal moraine of the last ice advance, it is apparent that their extent is restricted to a comparatively small area, and that the searches for new fishing banks south of the terminal moraine will be fruitless. This limited distribution emphasizes the need for the careful conservation of the exceptional wealth of common food fishes, particularly the cod and haddock, which flourish on these specially adapted habitats.

## FISHING METHODS, AND THE CONSERVATION OF THE FISH SUPPLY

Georges Bank is regarded by fishermen as one of the richest fish grounds in the world, and the Georges cod, which are here found in great size and abundance, are said to be the finest caught. The shoal water, the strong Bay of Fundy tide, and the frequency of gales make these banks exceedingly rough, and the record of disaster here is long and terrible.

Of late years improvements in design in the fishing vessels and method of fishing have lessened loss. February and March have seen the greatest number of shipwrecks. On the evening of Feb. 24, 1862, a terrible gale from the northwest burst suddenly upon the fishing fleet on Georges Bank, there being about 70 sail at anchor in a small space, for fish seem to congregate in comparatively small spots here. Without sufficient warning, they were unable to heave up anchors. Thirteen vessels with their entire crews were lost largely through collisions, and two abandoned. Nearly every vessel was damaged; one hundred and twenty men were lost, leaving 70 widows and 140 fatherless children.

Only a few vessels, known as "Georgiamen"—ancient hulks with crews of old fishermen aboard who use the hand line from deck—now anchor on Georges Bank, so danger of collision from parting cables has been greatly lessened. The modern fishing schooner with her yacht-like design rides out the hardest gales, either under her foresail or with a triangular riding sail set in place of the mainsail, she "jogs it out," *i. e.,* with one small sail set and trimmed flat down, she is left to ride out the gale in the wind's eye. This she usually accomplishes in a remarkably seaworthy way.

How the fish are caught to-day may be illustrated from the notes written during this recent trip:

*Saturday, March 16.* Leave " T " Wharf [Boston] at 10 A. M. Brisk northwest wind. Run down the harbor under jibs, and foresail is set. Course east by south. Wind lightens toward evening and continues thus through the night.

*Sunday.* East to northeast winds. Vessel close-hauled all day. The sea is smooth. We see a few schooners returning from Georges, and a steamship passes. Good weather continues throughout the night. Am awakened by the sawing of the lead line over the rail. It is shortly before daylight. We are in thirty-five fathoms of water, and on the northern edge of Georges Bank.

*Monday.* The skipper from his bunk gives the order to " bait up." Breakfast is ready in the forecastle; the men are below in the waist of the vessel baiting the trawls (long lines with many hooks attached) with chopped-up frozen squid. Several schooners now come into view, some within a mile or less, others near the horizon. They also are preparing to fish. Soon the first dory of the string of ten is hooked upon the tackles and lifted from the " nest " over the side. Two half kegs of baited trawl line are placed in each boat with a basket of extra squid bait. There is also a sail, two pairs of oars, gaff, fish fork, jug of water, a girdy, or hand windlass, to start the trawls, a pail, compass, some food, knife and anchor. Two dory mates tumble into the bouncing little boat and are cast off. One man rows, the other with a little stick throws out the trawl line hook by hook. As the vessel sails on, the other dories first from one side then the opposite quarter, are put overboard and set adrift about a fifth of a mile apart. The first dory is now but a speck in the horizon, seen occasionally as she rises on a sea. The schooner is headed back, passing down her line of busy fishermen to leeward of the first boat, and hauls up to wait.

An oar is raised in one of the dories. The skipper bears down toward it, the vessel is thrown into the wind, the dory's painter is caught, and the men begin to pitch upon deck the catch with which they have loaded the boat. It consists of medium-sized haddock and big codfish, many four feet long, weighing 30 pounds and over. Wooden partitions are set athwart-ships and held between the bulwarks and house by cleats, the cod and haddock being heaped in separate pens. Some of the fish are about all a man can lift on his three-tine fork. Other boats which have become laden by this time are also picked up, some running down the wind with their sails. The deck pens grow in number and become filled to overflowing with silvery haddock and huge, greenish, glass-eyed, gaping-mouthed codfish. The dorymen hurry below for a " mug up " —hot coffee and tea, and a "layout" of ham, corned beef, potatoes, pies, doughnuts, bread and butter, cheese, and whatnot, spread by the cook on the racked table.

By the time this pair of dorymen have swallowed a substantial lunch effected with great rapidity and are off again, another dory is alongside, with a heavy burden of still flapping fish. All day long, for this was an exceptionally good fish day, this program is repeated, the vessel ranging up and down trying to keep run of the dories which are continually getting out of vision, some drifted away by the strong wind or tide from others which have caught their gear on bottom and are " hung up " to windward. We counted twelve other schooners likewise tending their fishing boats. Just at dark in a rising wind the dories came for the last time, each being hoisted on deck and lashed down. The decks from the afterside of the cabin to the mainmast were now level full to the rail with fish, mostly large cod, thirty-five thousand pounds the skipper estimated.

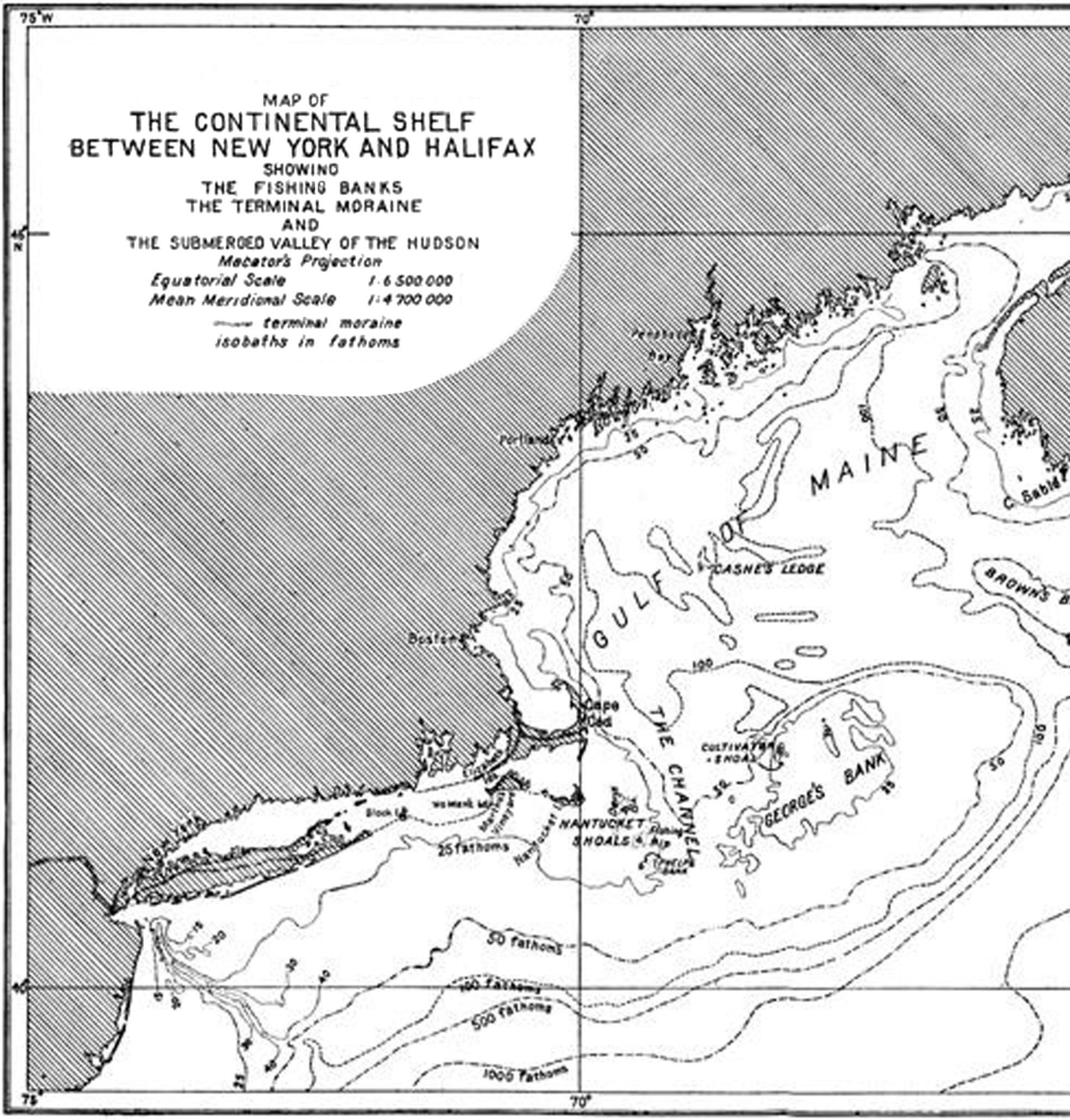
After supper the men hastened back on deck and under the light of a dozen flaring torches began to dress the fish. They were then washed in hogshead tubs, and when they were stowed away with chopped ice in the hole, it was late in the night and the weary workers, save the two whose turn it was to be on half hour watch, crawled into their stuffy bunks.

*March 23.* Not a " fish day." Seas ran high and frequently came aboard as we " jogged out " the gale. In the afternoon it let up somewhat. The mainsail and jumbo were set, and the vessel headed for Browns Bank, some 60 miles away to the northeast, where the skipper hoped to find large haddock. As we drew off the Bank into the deeper water of the channel, the sea became less disturbed.

Having sailed a ten-mile clip, sunset found us in 38 fathoms over Browns Bank, and here we " hove to " till daylight.

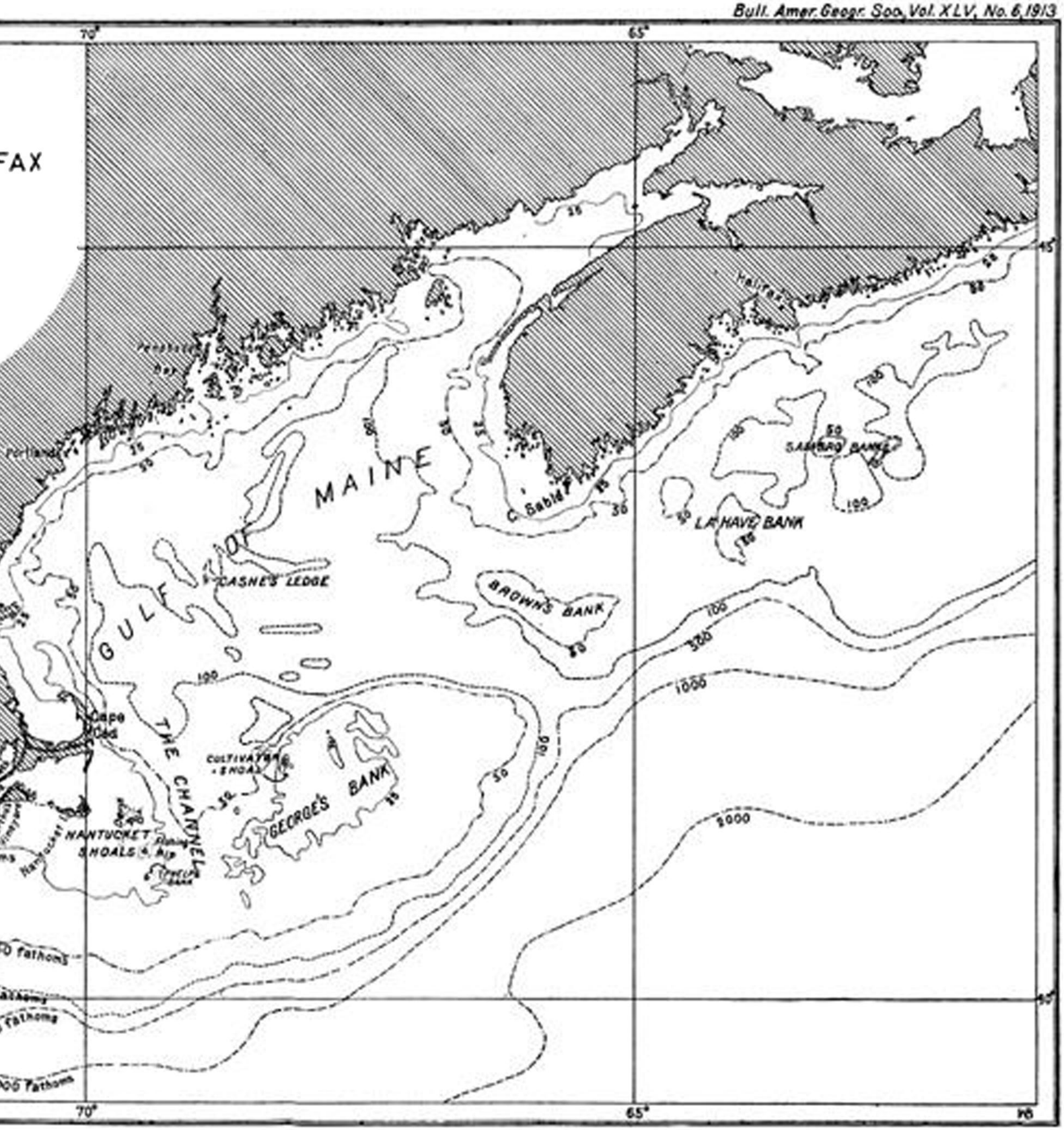
*March 24.* Wind and sea eased up during the night. At 2 A. M. the watch called the skipper, reporting soundings and a vessel's light. At 2.30 the cook was called, and all hands went on deck to bait trawls by torchlight. Breakfast was announced, and then the dories put overboard. For a while there was a good chance to fish, but the wind blew up, bringing thick, damp snow, and the skipper was glad to get back all the dories, which, as they came, were thrown violently against the schooner. The catch was good in fine large haddock. Some cusk and ugly looking catfish with long feline teeth and dragon-like heads were brought in, also a few halibut, one of 100 pounds, pollock and codfish.

On this cruise a comprehensive collection of rocks hauled up with the marine growth attached was gathered. There were long-stemmed stone lilies, crinoids, which the fishermen called " lemons," soft sea slugs or holothurians they called " pumpkins," a yellow growth termed " corn," sponges, and a large variety of other marine life. The rocks of Browns Bank were of similar character to those of Georges Bank, though seemingly of greater variety, somewhat smooth and rounded, but subangular. Quartz and quartzite predominated both in sand and pebbles. Slates, granites, diorites, schists, sandstones, similar to the variety usually found in glacial deposits on the neighboring shore, were abundant, testifying to the glacial origin of these sea banks.



MAP OF
THE CONTINENTAL SHELF
BETWEEN NEW YORK AND HALIFAX
SHOWING
THE FISHING BANKS
THE TERMINAL MORAINE
AND
THE SUBMERGED VALLEY OF THE HUDSON
*Mercator's Projection*
*Equatorial Scale* 1:6 500 000
*Mean Meridional Scale* 1:4 700 000
*terminal moraine*
*isobaths in fathoms*

Bull. Amer. Geogr. Soc. Vol. XLV, No. 6, 1913



The formation of these fishing shoals indicates that it will be useless to look for new banks south of the glaciated area, or about north latitude 40°. Soundings on the continental shelf north of this parallel are now complete enough to assure us that no new banks of any considerable extent will be discovered. The need of saving for the future this vast source of wealth, which, unlike our mineral resources, is self-perpetuating if properly conserved, more firmly impresses itself when it is thus seen how limited is the distribution of these specially adapted formations. They are far enough from shore to prevent the smothering by fine coastal sediments of the multitudinous marine life, which here finds a pebbly bottom, cleaned by strong tides on which it can attach itself and grow, a most prolific sort of feeding ground for the great schools of our finest food fishes.

It seems desirable that some action should be taken to protect the fish during the spawning season, at least for a period of years. There is also the greater danger that the now wholesale and destructive method of fishing with the steam trawler may cause irreparable and permanent damage to these natural beds. This method, which has already played great havoc with the fishing grounds of the European coasts, so that vessels which once operated about the British Isles must go as far as Iceland on the north and Portugal on the south for their catches, is at present being attempted in this country, and a gradually increasing fleet of steam otter trawlers is now plying between the banks and the Boston market.

The beam trawler tows over the bottom a great open net which scours the ground like a great harrow and engulfs nearly everything, big and little, with which it comes into contact. Not only does it disturb and destroy the delicate growths and fish food of the bottom, but vast quantities of small and unmarketable fish besides, which are crowded into the great maw of the open net and either smothered or killed when dumped on deck.

These trawls are ceaseless in their destruction, for they are towed under nearly all conditions at night as well as day, while the line fishermen must wait for moderate weather. They also pick up, without discrimination, the sick and spawning fish which will not bite the baited hooks. This method of fishing tends to create a monopoly, as the costly steam vessels require large capital to build and operate and their increase will naturally tend to drive out the hardy independent men of modest means who are to-day engaged in line fishing on the small schooners. These line fishermen are undoubtedly the best sailors we have; they are resourceful, brave and efficient, largely because they all, crew, cook and skipper, are either owners or share in every fare of fish. In time of war they form our greatest source for first-class seamen. The beam trawler is operated by nondescript "steamboat sailors off the street" and controlled by interests who need never go near the sea.

To judge the urgent need of restricting steam trawling fishing on this continent—for the fishing banks are an essential part of the shallow coastal shelf and should be regarded as part of the natural continent—we have but to glance at the present situation in Europe where beam trawl fishing has nearly put an end to the earlier methods, and where much legislation has already been passed to restrict this destructive means, though not until the adjacent supply of market fish was reduced to 25 per cent of what it was some 15 years ago and it became necessary to go four times the former distance for fish. A large number of small English and Scotch fishing towns have been obliged to give up the fish business, as Whitley, Scarboro, Stalhier, Bradlington. The once rich Dogger Bank fishing has been, as a profitable industry, destroyed, and fish of the market size to which we are accustomed have practically disappeared in nearby English waters. Among 70 Billingsgate dealers recently only one had fish of market size, these consisting of three boxes of Iceland cod and haddock. The European consumers are obliged to eat skate, ling, catfish and other "culch" which Americans do not use.

Nature has so arranged limited areas off our coast that they are veritable mines of self-perpetuating wealth and inexpensive food for the people. Shall we, regardless of the overseas disaster already wrought, run the risk of losing one of the remaining natural sources of food supply which with judicious use may doubtless be saved for the future?